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Trophic level and Position of *Pterygoplichthys pardalis* in Ciliwung River ecosystem based on the gut content analysis

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This article is the result of our research that has been funding by The Ministry of Research and Technology, Higher Education in 2018. The novelty of this study is the result of research that explains the trophic level and position of *Pterygoplichthys pardalis* in Ciliwung river. It's explains something new that have never been found in another research with the object *Pterygoplichthys pardalis* in Ciliwung river Indonesia.

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Trophic level and Position of *Pterygoplichthys pardalis* in Ciliwung River ecosystem based on the gut content analysis

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Abstract. The trophic level of an organism describes its sequence of natural diet visible to the food chain along with its ecosystem. This is also related to the type of diet composition and food fraction obtained by analyzing its gut content. The *Pterygoplichthys pardalis* from Ciliwung River show the diversity of the natural diet. However, no information has been provided on its trophic level in the ecosystem. This study, therefore, aims to determine the trophic level and position of *Pterygoplichthys pardalis* in the Ciliwung River ecosystem based on the gut content analysis using the purposive sampling method. Data were obtained from a total of 30 *fishes* from the Kalibata and Cawang areas through observations. The fishes were dissected, and gut contents were observed using a light microscope, with observations repeated 5 times of each sample. The results showed that *Pterygoplichthys pardalis* in Ciliwung River is at trophic level II, and included as herbivores (2.00 < troph < 2.90) *that consist of Bacillariophyta* (82.03%), *Chlorophyta* (12.7%), *Cyanophyta* (3.74%), *Euglenophyta* (1.19%), *Amoebozoa* (0.28%), and *Dinoflagellata* (0.68%).

Key words: Ciliwung River, gut content, natural diets, *Pterygoplichthys pardalis*, trophic level

Running title: Trophic level of *P. pardalis* in Ciliwung

INTRODUCTION

Pterygoplichthys pardalis is an invasive species originating from Central and South America (Armbruster, 2004). It migrated into Indonesia through the ornamental fish trade route and has the ability to survive under highly polluted environment, due to a modification in its gastric system which functions as an additional respiratory organ that aids it to survive in areas that lack dissolved oxygen (Ambruster, 1998). Its strong adaptations led to the abundance of native fish in the Ciliwung River. The percentage loss rate of native fish diversity in the river reached 92.5% from 1910-2010. This is due to the presence of *Pterygoplichthys pardalis* (Hadiaty, 2011). However, the availability of food resources is one of the factors that influence the existence of fishes. Previous studies have also established that a correlation exists between the structure of the digestive apparatus and the feeding habits of fishes (Manna, et al., 2020).

The type of diet consumed is generally influenced or determined by the morphological character of species (Mazzoni, et al., 2010; Delariva & Agostinho, 2001). For instance, *Pterygoplichthys pardalis* has a suction type of ventral mouth, which allows fish to scrape food from rough surfaces (Samat, et al., 2016). The shape of its mouth and its position is an adaptation pattern that aids fishes to obtain food. The position of the *Pterygoplichthys pardalis* mouth is inferior due to its downward direction, thereby making it possible to suck various types of food in the water base. It is also known as eaters of algae, invertebrates such as snails, detritus, and food at the bottom of the water (Sharpe, 2016) (Mazzoni, et al., 2010).

Generally, members of the Loricariidae feed on diets consisting of plant fragment, zooplankton, arthropods, chlorophytes, bacillariophytes, cyanobacteria and cyanobacteria (Manna, et al., 2020); (Tisasari, et al., 2016); (de Oliveira & Isaac, 2013); (Mazzoni, et al., 2010). *Pterygoplichthys sp* discovered in Sungai Langat, Malaysia, is known to eat algae, plants, and animal fragments (Samat, et al., 2016). In addition, it relates to the availability of diet resources and the environmental state of the water. The trophic level of an animal is influenced by the composition of its diet and the trophic level of each food fraction of which data is obtained from analyzing its stomach contents (Mearns, 1981).

Presently, no data explains the trophic level and position of *Pterygoplichthys pardalis* in its ecosystem in accordance with the type of natural diet contained in the river. Due to this reason, it is necessary to conduct research aimed at analyzing the trophic level of *Pterygoplichthys pardalis* in the ecosystem of the Ciliwung River based on gut content analysis. Subsequently, information obtained from this research is useful and serves as a source of data needed to manage the Ciliwung River.

MATERIALS AND METHODS

Study area

Sampling was carried out along the Ciliwung River from the Rindam Jaya area to Bidara Cina. The analysis of fish samples was conducted at the Ecology Laboratory at the Integrated Laboratory Center, Syarif Hidayatullah State Islamic University Jakarta.

This research consists of three observations and sampling stations namely St1, St2, and St3. The coordinates are as follows: St1 S 06.244053°-E 106.862654º, St2 S 06.25830°-E 106.86040°, and St3 S 06.28599°-E 106.84717° as shown in Figure 1.

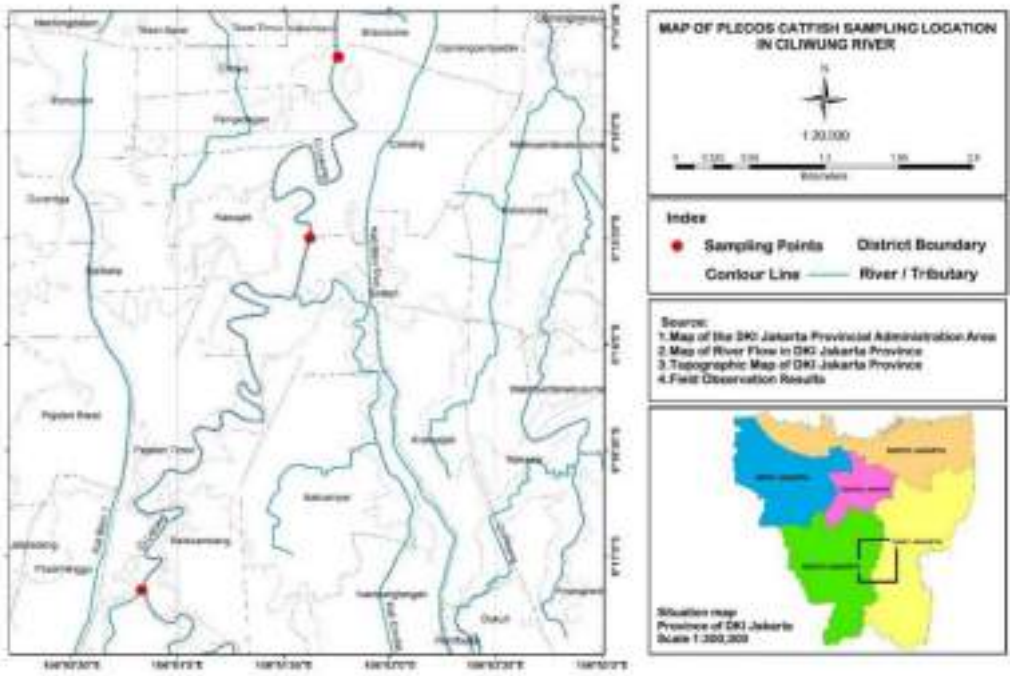


Figure 1: Three observation and sampling station along Cawang-Condet of Ciliwung River

The research conducted includes collecting fish samples, which were divided into 3 groups based on its size and length, namely large (34,0-41,5 cm), medium (26,4-33,9 cm), and small fish group (18,7-26,3 cm).

Procedures

Sampling methods

The determinant of the sampling point is done by using purposive sampling method, which is based on the presence of plecos in the Ciliwung River Kalibata area (coordinates: S 06.244053°-E 106.862654°) and Cawang (coordinates; S 06.28599°-E 106.84717°)

Relative Length of Gut

Measurement of the relative length of gut (RLG) is one of the methods used to distinguish fish based on the type of food they consume. It is determined by measuring the length of the digestive tract and body. Measurement of the relative length of the gut was calculated by the formula (Zuliani, et al., 2016).

$$RLG = \frac{GL}{TL}$$

Note:

RLG = Relative Length of Gut

GL = Gut length

TL = Total length

The results from the measurement of the fish's RLG is distinguished in accordance with the following categorized values

< 1 = fish classified as carnivorous

1-3 = fish classified as omnivorous

>3 = fish classified as herbivorous

Gut Contents Analysis

The observation was carried out using the dilution of the gut contents, furthermore 2 drops were placed on the slide using a pipette. The samples were viewed under a binocular light microscope with magnification ranging from 100x, 400x, and 1000x using immersion oil (Tisasari, et al., 2016); (Widarmanto, et al., 2019)

Index of Preponderance

The Index of Preponderance was used to determine the various types of plecos fish food. It is used to analyze the percentage of the largest part of the organism consumed by combining the frequency of occurrence and volumetric method using the formula (Effendie, 1997).

$$IP = \frac{Vi \; x \; Oi}{\sum(Vi \; x \; Oi)} \; x \; 100\%$$

Note:

IP = *Index of Preponderance*

Vi = volume percentage of one type of food

Oi = frequency percentage of one type of food occurrence

$\sum$(Vi x Oi) = the amount of Vi x Oi of all types of food

The volumetric method is conducted by comparing the types of organisms discovered in the channel with the volume of the liquid. However, this is obtained by calculating the average species consumed, based on the number of individuals (Hyslop, 1980).

The following formula determines the volume percentage of one type of food.

$$Vi = \frac{number \; of \; individuals \; in \; one \; type \; of \; food}{total \; of \; all \; types \; of \; food} \; x \; 100\%$$

Note:

Vi = Volume percentage of one type of food

The frequency of occurrence is a simple method of collecting data in accordance with the contents of the stomach, which consists of either a particular or various types of organisms (Hyslop, 1980). The percentage of the occurrence frequency of a particular type of food is determined by the formula

$$Oi = \frac{the \; number \; of \; tracts \; that \; contain \; one \; type \; of \; food}{as \; well \; as \; the \; total \; number \; of \; the \; stomach \; that \; contains \; food} \; x \; 100\%$$

Note:

Oi = Occurrence frequency

Based on the percentage Index of Preponderance, the food is divided into three categories

IP> 40% main food

IP 4%-40% supplementary food

IP < 4% additional food

Area of the diet niche

The area of the diet niche is measured by understanding the distribution of individual organisms which is the source (Colwell & Futuyma, 1971), in addition, it is calculated based on the food consumed by fish using the Levin Index as follows:

$$B = (\sum Pi^2)^{-1}$$

Note:

B = area of the diet niche

$\sum$Pi = total proportion of the i-th type of food consumed

Niche Area

Standardisation is often used to express the diet niche area on a scale of 0 to 1, however, it is obtained by dividing the Levin Index result by the number of food types consumed by the fish.

$$Ba = \frac{B-1}{n-1}$$

Note:
Ba = Standardisation of levins' niche area
B = Niche area
N = Types of food consumed by fish

Niche Overlap

Niche overlap tends to occur when one or more organisms obtain food from a particular source using the following formula (Tresna, et al., 2012).

$$Ch = \frac{2\sum Pij.Pik}{\sum Pij^2 + Pik^2}$$

C_H = Morisita Index
Pij, Pik = Proportion of species of i-th food organism used by two groups of j-th fish and k-th fish groups, in the same population

Trophic Level of an organism

The trophic level of an organism is determined by counting the food fraction, which is obtained by the number of individuals per organism divided by the total number of individuals found in a particular group of fish with similar sizes. The trophic level is calculated with the following formula

$$Trophi = 1 + \sum DCij \; x \; Trophj$$

Troph-i = Trophic level i-th fish
DCij = j-th food fraction eaten by i
Troph-j = Trophic level fraction of j-th food

Based on the analysis, the trophic level is categorized into
2,00 < Troph < 2,9 category II fish as herbivore
2,9 < Troph < 3,7 category III fish as carnivore
3,7 < Troph < 4,5 category IV fish as carnivore

RESULTS AND DISCUSSION

Relative Length of Gut of *Pterygoplichthys pardalis* from Ciliwung river

The results from the analysis of the relative length of gut (RLG) showed that the *Pterygoplichthys pardalis* found in the Ciliwung River is included in the category of herbivorous fish. This is observed in the RLG values for each group of fish. The RLG from large to small fish groups are 10,98 cm, 11,17 cm, and 17,49 cm, respectively. Based on these values, *Pterygoplichthys pardalis* is included in the category of RLG > 3, as shown in Table 1.

Table 1: Relative Length of Gut in each fish category

Fish Categories	Total Length (TL)	Gut Length (GL)	RLG (cm)
Large fish	37,03	406,75	10,98
Medium fish	31,73	354,6	11,17
Small fish	21,64	378,53	17,49

The relative length of the gut is used as an indicator of the fish's feeding habits by comparing its length to the total length (Fariedah, et al., 2017); (Delariva & Agostinho, 2001). According to a research conducted by Tisasari, fish classified as herbivores usually have a total gut length of 5,9 times the body length (Tisasari, et al., 2016). Gut length is influenced by the fish's feeding patterns, which is observed in the relationship between the diet type and the gut length. *Rhinelepis aspera* has a significantly different gut length from *Megalancistrus aculeatus* because it has an entirely different diet type, however, both are species of *Loricariidae* (Delariva & Agostinho, 2001).

Pterygoplichthys pardalis has a relatively long gut and is classified as herbivore however, and digestion lasts longer compared to fish in the other groups. The structure of the gut shows a strong adaptation to any diet type. Plecos fish diet type includes plant fragments, algae, and detritus. Algae and detritus are hard to digest and require longer mechanical power. The digestive process requires a large area for absorption, and this causes elongates the gut of the pleco (Samat, et al., 2016).

***Pterygoplichthys pardalis* Gut content in Ciliwung river**

The results from the analysis of the gut content of *Pterygoplichthys pardalis* in the Ciliwung river showed that the various types of natural fish diet are grouped into *Bacillariophyta, Chlorophyta, Cyanophyta, Euglenophyta, Amoebozoa, Dinoflagellata*, and detritus as shown in table 2. *Bacillariophyta* is commonly found in the guts of plecos fish compared to the others. Conversely, these groups were discovered in as many as 59 genera. Generally, the *Bacillariophyta* group is found in sediments and substrates of both mild and strong currents (Harmoko, 2018); (Genkal & Yarushina, 2016); (Buck & Sazima, 1995). This is consistent with the feeding behavior of *Pterygoplichthys pardalis* as a bottom feeder fish, because this group is a type of phytoplankton that is widely attached to sediments or substrates (Genkal & Yarushina, 2016) (Genkal & Yarushina, 2014); (Buck & Sazima, 1995). The type of diet consumed by *Pterygoplichthys pardalis* determines the feeding habits in the Ciliwung river.

Table 2. The composition of the *Pterygoplichthys pardalis* natural diets in the Ciliwung river in accordance with gut content analysis

Category	Type
Bacillariophyta	Achnanthes sp., Achnantidhium sp., Amphipleura sp., Amphora sp., Aneumastus sp., Aulacoseira sp., Bacillaria sp., Caloneis sp., Climacosphenia sp., Cocconeis sp., Craticula sp., Cyclotella sp., Cymbella sp., Cymbopleura sp., Diadesmis sp., Diatoma sp., Diploneis sp., Encyonema sp., Entophysalis sp., Encyonopsis sp., Eolimna sp., Eunotia sp., Ephitemia sp., Fallacia sp., Fragilaria sp., Frustulia sp., Geissleria sp., Gomphoneis sp., Gomphonema sp., Grammatophora sp., Gyrosigma sp., Halamphora sp., Hantzschia sp., Luticola sp., Lemnicola sp., Lyrella sp., Mastogloia sp., Melosira sp., Navicula sp., Neidium sp., Nepula sp., Nitzschia sp., Oedogonium sp., Pinnularia sp., Placoneis sp., Planothidium sp., Prestauroneis sp., Rhoicospenia sp., Rivularia sp., Rhopalodia sp., sellaphora sp., Stauroneis sp., Stenopterobia sp., Stephanodiscus sp., Surirella sp., Synedra sp., Tabularia sp., Trybllionella sp., Ulnaria sp.
Chlorophyta	Ankistrodesmus sp., Asterococcus sp., Bulbochaete sp., Chlamydomonas sp., Chlorella sp., Chlorococcum sp., Chlorococcus sp., Closterium sp., Choricystis sp., Coleastrum sp., Cosmarium sp., Crucigenia sp., Desmodesmus serratus, Dictyochloropsis sp., Dictyococcus sp., Dictyosphaerium sp., Eudorina sp., Haematococcus sp., Microspora sp., Monoraphidium sp., Oocystis sp., Oophila sp., Palmellopsis sp., Pediastrum sp., Planktosphaeria sp., Scenedesmus sp., Selenastrum sp., Staurastrrum sp., Steogclomium sp., Tetrastrum sp., Tetraedron sp., Tetraspora sp., Volvox sp., Zygnema sp.
Cyanophyta	Anabaena sp., Aphanizomenon sp., Aphanocapsa sp., Aphanothece sp., Arthrospira sp., Chlorogloea sp., Chroococcus sp., Gloeocapsa sp., Gleocapsopsis sp., Gloeocystis sp., Gloeothece sp., Gloeothichia sp., Merismopedia sp., Neospongiococcum sp., Nostoc sp., Phormidium sp., Pseudocapsa sp., Pseudonabaena sp., Rivularia sp., Synechococcus sp., Tychonema sp.,
Euglenophyta	Euglena sp., Lepocinclis sp., Phacus sp., Trachelomonas sp., Wailesella sp.
Amoebozoa	Arcella sp., Centropyxis sp., Clypeolina sp., Pyxidicula sp.,
Dinoflagellata	Prorocentrum sp.
Detritus	Meliola sp., Pestaliotiopsis sp.

The results from the gut content analysis, showed that the calculated percentage of natural diet consumed by *Pterygoplichthys pardalis* is 82.03% *Bacillariophyta*. Therefore, it is the commonest type of natural diet, with *Chlorophyta*, *Cyanophyta*, *Euglenophyta*, *Amoebozoa*, *Dinoflagellata*, and detritus at 12.17%, 3.74%, 1.19%, 0.28%, 0.68%, and 0%, respectively as shown in Figure

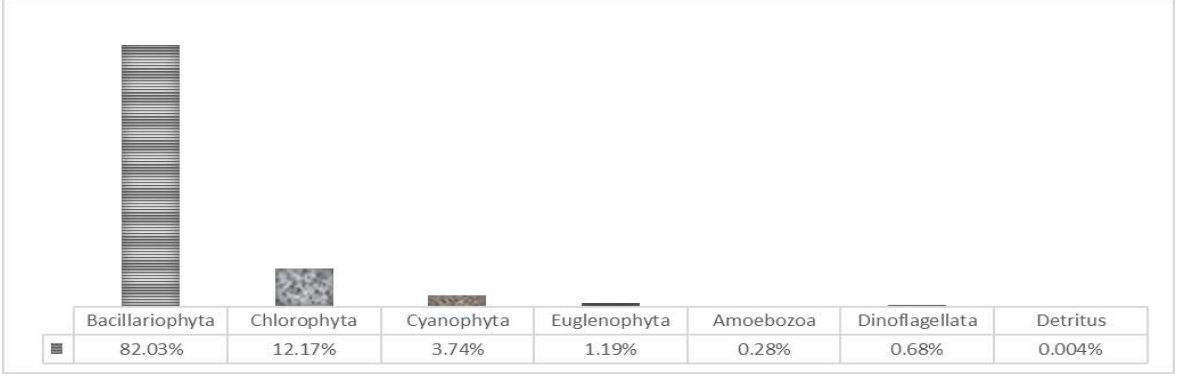


Figure 2: Percentage of *Pterygoplichthys pardalis* natural diet in the Ciliwung River based on gut content analysis

Bacillariophyta is used as the primary source of the natural diet for the *Pterygoplichthys pardalis* in the Ciliwung river because its habitat is at the bottom of the water, and it supports the characteristics of the mouth shape of plecos fish. According to the results from the study conducted by Pambudi in 2015, *Bacillariophyta* had the highest abundance compared to other divisions found in the river, followed by *Chlorophyta* (Pambudi, et al., 2016).

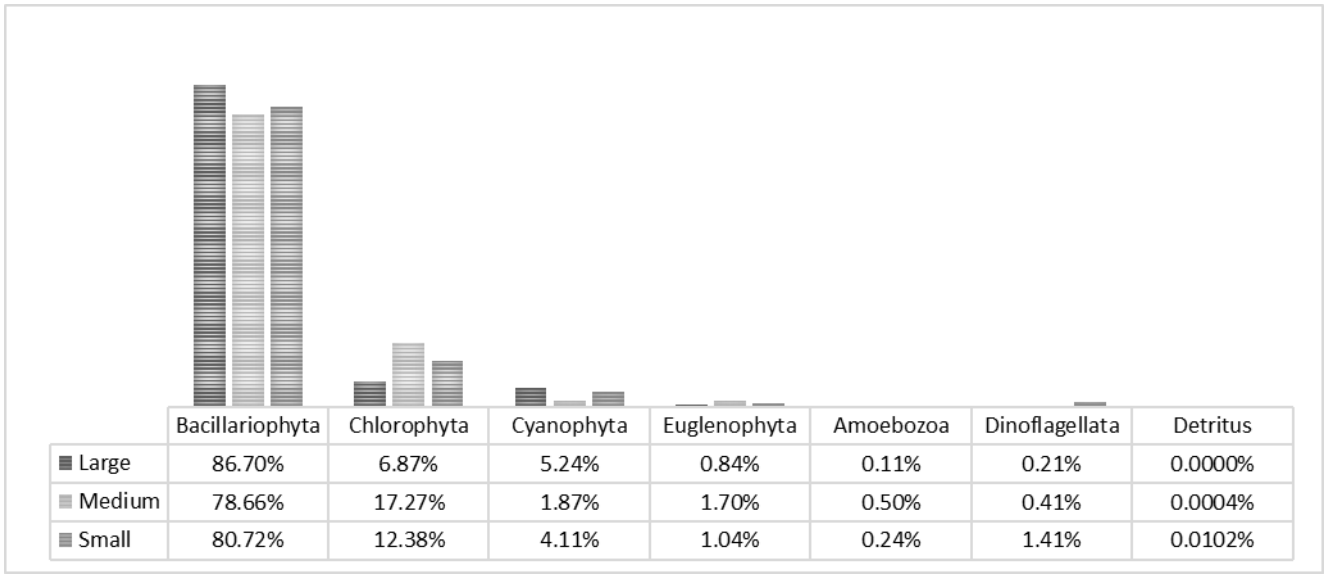
Plecos consumes phytoplankton, zooplankton and detritus as its main (56.39%), supplementary (36.94%) and additional (6.67%) diets. These results are similar to those obtained in the research conducted by Tisasari which stated that pleco's main diet are *Bacillariophyta*, *Chlorophyta* and *Cyanophyta* serve as supplementary foods, while *Eugleophyta, Xanthophyta, Crustacea* are additional diet (Manna, et al., 2020); (Tisasari, et al., 2016); (de Oliveira & Isaac, 2013). The dissimilarities in the feeding habits of fishes tend to occur as a result of the differences in the availability of food utilized in its natural habitat. According to Effendi, fish's preference for diet is relative. Additionally, the distribution of food organisms, availability of natural diet, and physical conditions tend to influence their feeding habits (Effendie, 1997). Therefore, greater availability of food resources in the invaded habitats provided conditions that are conducive for the establishment of non-native species (Garcia, et al., 2018); (Delariva & Agostinho, 2001).

***Pterygoplichthys pardalis* Index Preponderance in Ciliwung river**

Index Preponderance (IP) explains the natural diet preferences of *Pterygoplichthys pardalis*. Subsequently, IP based on the different types of fish groups shows similar diet preferences. The three groups of *Pterygoplichthys pardalis* utilizes *Bacillariophyta* as its main natural food. The IP values of *Bacillariophyta* in the large, medium and small fish groups are 86.70%, 78.66%, and 81.11%, respectively, as shown in figure 1. The preference of *Bacillariophyta* as the main natural diet for *Pterygoplichthys pardalis* shows that its availability in the river is quite abundant. In addition, it is a type of microalgae that is epilitic, thereby making it is suitable for *Pterygoplychthys pardalis*. Morphologically, *Pterygoplichthys pardalis* has a triangular mouth shape suited towards the ventral that supports its feeding habits. This is due to the fact that it belongs to the group of algae-feeding fish that covers the bottom surface of the water. The morphology of the mouth's shape and structure allows the fish to erode food from hard surfaces and swallow soft sediments efficiently (Samat, et al., 2016).

The IP value of *Chlorophyta* in the large, medium, and small fish groups are 6.87%, 17.27%, and 12.40%, respectively. Conversely, the IP value of *Cyanophyta* in the large, medium, and small fish groups are 5.24%. 1.87%, and 4.11%, as shown in figure 3. This showed that they are a type of natural supplementary diet for *Pterygoplichthys pardalis* in the Ciliwung river. The abundance of *Cyanophyta* in the river ranks third after *Bacillariophyta* and *Chlorophyta* (Pambudi, et al., 2016). This statement is supported by the results from the research which stated that *Chlorophyta* and *Cyanophyta* discovered in the guts of plecos fish in the Langat River, are relatively abundant in the habitat (Samat, et al., 2016). According to Sulistiono, fishes generally adjust the food types to the size of their mouth openings, while the larger ones tend to consume more food (Sulistiono, et al., 2009).

The IP analysis obtained, showed that *Pterygoplichthys pardalis* is included in the opportunist fish group because it is able to utilize the food available in the river. Plecos fish consumes phytoplankton as its main food (56.39%), while zooplankton serves its supplementary food (36.94%) and detritus as the additional food (6.67%) (Tresna, et al., 2012). However, *Pterygoplichthys pardalis* consumes *Bacillariophyta* as its main food, *Chlorophyta* and *Cyanophyta*, as its supplementary foods, while *Euglenophyta, Xanthophyta, Crustacea serves* as additional foods (Manna, et al., 2020); (Mazzoni, et al., 2010); (Tisasari, et al., 2016). The differences in feeding habits of a particular type of fish tend to occur due to dissimilarities in the availability of food utilized in its natural habitat. Distribution of diet organisms, availability of food in the habitat, species of fish, and physical conditions influences feeding habits (Sofarini, et al., 2019); (de Oliveira & Isaac, 2013); (Effendie, 1997). It is also influenced by competition between individuals, predators, food chains from broad areas, and overlapping food niches (Manna, et al., 2020); (Effendi, 2003).



	Bacillariophyta	Chlorophyta	Cyanophyta	Euglenophyta	Amoebozoa	Dinoflagellata	Detritus
Large	86.70%	6.87%	5.24%	0.84%	0.11%	0.21%	0.0000%
Medium	78.66%	17.27%	1.87%	1.70%	0.50%	0.41%	0.0004%
Small	80.72%	12.38%	4.11%	1.04%	0.24%	1.41%	0.0102%

Figure 3. Index Preponderance of natural diet in each group of *Pterygoplichthys pardalis* in the Ciliwung River

Feeding Niches Area

The feeding niches area is a description of the proportion of the various food consumed by a particular type of fish (Giller, 1984). The area of the feeding niche showed the size of the fish group that utilizes the available organisms as its natural diet source, in addition, it also utilizes aquatic resources (de Oliveira & Isaac, 2013); (Sulistiono, et al., 2009). Analysis of the feeding niche area is determined by the number and size of the different types of individuals in each group. Standardization is conducted to obtain a broad variety of niches ranging from 0-1 intervals between variables that are not similar (Izzani, 2012).

The results from the analysis of *Pterygoplichthys pardalis* feeding niche area in the Ciliwung river in accordance with the group differences showed that the large fish group has a larger niche area 42,87 compared to the other groups with standardization of 0.22 (table 3). The huge value is expected because the fish are able to utilize the resources available in large quantities. However, this value is influenced by the number of the different types of food consumed by a particular group of fish with a relatively large niche area tends to have an increased number of species that are utilized as their food sources (Tresna, et al., 2012). It also implies that the fish group tends to evenly utilize all available resources in the aquatic environment as their natural diet (Elinah, et al., 2016). Besides, the size of the fish also affects the external diet niche. The feeding niche area for fishes is influenced by its length and size in their habitats (Hedianto, et al., 2010).

Table 3. The area of niches and standardisation in each size category

Category	Size	Niche Area	Standardization
Large fish	340 - 415 mm	42.87	0.22
Medium fish	264 - 339 mm	36.01	0.19
Small fish	187 - 263 mm	16.78	0.07

The medium size fish group has a niche value of 36.01 with a standardization of 0.19 (table 3). This value is lower than that of the large fish group, and its decrease is due to the differences in the utilization of diet resources in the river. Therefore, fish with a lower niche area means that its group tends to be more selective in utilizing resources (Hedianto, et al., 2010).

The small size fish group has a lower niche area value of 16.78 with 0,07 standardization as shown in table 3, because it uses food selectively. Fish that have a relatively small niche area uses less food types, and they specialize in utilizing diet resources (Sentosa & Satria, 2015).

The joint use of available diet resources by the fish size groups tends to cause overlapping niches (Sentosa & Satria, 2015). Overlapping occurs when the food resources are shared by two or more types of fish (Krismono, et al., 2008)

The results from the analysis of overlapping niches showed that the relationship between the large and medium fish groups has a greater value (0.77) compared to that of other groups (table 4). The value of overlapping niches implies the presence of organisms that are shared between the groups. It also showed the similarity in resource utilization of 0.77. High overlapping values cause large and medium fish groups to compete for food.

Table 4. The intraspecific overlapping value between fish groups

Category	Large	Medium	Small
Large		0.77	0.42
Medium			0.43
Small			

The overlapping relationship between large and small fish groups is 0.42, and that of the medium and small fish groups have a similarity value of 0.43 (table 4). This means that the overlapping relationship between the medium and small groups, large and small groups, is lower compared to that between large and medium groups. The low value showed that there are differences in the organisms used. In addition, it is suspected that this reason led to a huge increase in the number of small and medium fish that was simultaneously discovered in the Kalibata area.

The value of overlapping feeding niches is approximately one (1). This means that similar resources are used which caused the 2 groups of fish to be highly competitive between two groups of fish. Overlapping values that are approximately zero (0) showed the differences in diet types between the two groups (Krismono, et al., 2008). Furthermore, overlapping of niches tends to occur when there are similarities in the diet types that are shared by two or more groups of fish (de Oliveira & Isaac, 2013); (Izzani, 2012). The overlapping values of each group tend to trigger interactions or compete for food in the same location (de Oliveira & Isaac, 2013); (Krismono, et al., 2008).

Pterygoplichthys pardalis trophic level in the Ciliwung River

The results from the analysis of the trophic level of *Pterygoplichthys pardalis* in the Ciliwung River showed no difference in each of the groups. The value of *Pterygoplichthys pardalis* trophic level in the river is 2.00, which means that it is classified as group II herbivorous fish. This is in accordance with the trophic level category values(2.00 < troph < 2.90). Herbivorous fish belong to group II because they eat phytoplankton, which is a type of food fraction at the trophic level of group I (figure 3). Fish species classified as herbivores consume plants, phytoplankton, and detritus (Hedianto et al. 2010). The analysis of trophic level supports Samat's statement that plecos fish have long guts and belong to the herbivorous group that feeds on algae and detritus (Samat, et al., 2016) besides, the environmental conditions are important for diet composition (Manna, et al., 2020).

Pterygoplichthys pardalis is classified as a level I consumer and belongs to the herbivorous group, however, this causes it to compete with native fish for food. According to Tresna, Wader (*Mystacoleucus marginatus*)and silver rasbora (*Rasbora argyrotaenia*) are native fish from Cimanuk river, Garut subsequently, the composition of their natural diet consist of plankton, plant fragments, and detritus (Tresna et al. 2012). Native fish tend to compete with *Pterygoplichthys pardalis due to* the composition of a natural diet *in* the feeding habitat. The ability of fish to adapt to environmental conditions is a determinant of its adaptation in the river (Sofarini, et al., 2019). *Pterygoplichthys pardalis* is able to survive in a polluted aquatic environment, however, it is also supported by morphological characters, such as an additional respiratory organ that functions as a respirator in poorly dissolved oxygen conditions (Moroni, 2015). These fish possess hard and prickly scales therefore there are no predators in the waters (Hadiaty, 2011). The migration of *Pterygoplichthys pardalis* in the waters of the Ciliwung river disrupted the food chain due to their feeding habits because they tend to feed on benthic algae and compete with native fish (Rao, 2017).

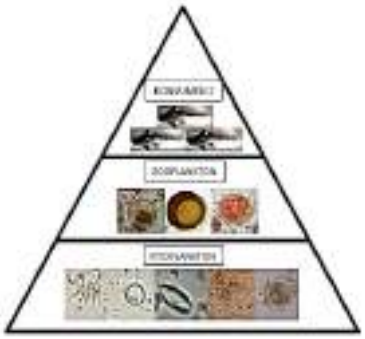


Figure 3. The trophic level of plecos fish in Ciliwung River.

In conclusion, the *Pterygoplichthys pardalis* belongs to the group II (2.00 < trophies < 2.90) trophic level and is classified as a herbivorous fish in the ecosystem of the Ciliwung river. The composition of its natural diet consists of *Bacillariophyta, Chlorophyta, Cyanophyta, Euglenophyta, Dinoflagellata, Amoebozoa*, and detritus in the riverbed with *Bacillariophyta as its main natural diet* at a preference value of 82.03% (IP> 40%). Meanwhile, its supplementary diet consist of 12.17% (IP 4-40%) of *Chlorophyta* and additional diet (IP<40%) of *Cyanophyta* (3.74%), *Euglenophyta* (1.19%), *Amoebozoa* (0.28%), *Dinoflagellata* (0.68%) and detritus 0.00%.

ACKNOWLEDGEMENTS

The authors are grateful to the Ministry of Research and Technology of Higher Education for the funds provided through the Directorate. The authors are also grateful to all those that contributed to this research.

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Subject : [biodiv] Submission Acknowledgement
To : Dewi Elfidasari <d_elfidasari@uai.ac.id>
Reply To : Ahmad Dwi Setyawan <editors@smujo.id>

Dewi Elfidasari:

Thank you for submitting the manuscript, "Trophic level and Position of Pterygoplichthys pardalis in Ciliwung River ecosystem based on the gut content analysis" to Biodiversitas Journal of Biological Diversity. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Submission URL: https://smujo.id/biodiv/authorDashboard/submission/5754
Username: elfidasaridewi

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

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Ahmad Dwi Setyawan

Re: [biodiv] New notification from Biodiversitas Journal of Biological Diversity

From : Dewi Elfidasari <d_elfidasari@uai.ac.id> Jum, Apr 17, 2020 09:00 AM
Subject : Re: [biodiv] New notification from Biodiversitas Journal of Biological Diversity
To : Deka <sectioneditor5@smujo.id>, Ahmad Dwi Setyawan <editors@smujo.id>

Dear Biodiversitas Editor

I have submitted the revised manuscript according to the advice of the reviewer regarding the manuscript references

Thank you

From: "Deka" <smujo.id@gmail.com>
To: "Dewi Elfidasari" <d_elfidasari@uai.ac.id>
Sent: Thursday, April 9, 2020 3:54:55 PM
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To : Dewi Elfidasari <d_elfidasari@uai.ac.id>

Reply To : Smujo Editors <editors@smujo.id>

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From : Smujo Editors <smujo.id@gmail.com> Rab, Mei 27, 2020 05:38 PM

Subject : [biodiv] Editor Decision

1 attachment

To : Dewi Elfidasari <d_elfidasari@uai.ac.id>, Fahma Wijayanti <fahma.wiyaja@yahoo.com>, Afifah <afifatussholihah08@gmail.com>

Reply To : Smujo Editors <editors@smujo.id>

Dewi Elfidasari, Fahma Wijayanti, Afifah:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "Trophic level and Position of Pterygoplichthys pardalis in Ciliwung River ecosystem based on the gut content analysis".

Our decision is: Revisions Required

Smujo Editors
editors@smujo.id

Reviewer A:

The manuscript is of good scientific quality. There is just some comments put in the text.

Recommendation: Accept Submission

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[biodiv] Editor Decision

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Subject : [biodiv] Editor Decision

To : DEWI ELFIDASARI <d_elfidasari@uai.ac.id>, FAHMA WIJAYANTI <fahma.wiyaja@yahoo.com>, AFIFATUS SHOLIHAH <afifatussholihah08@gmail.com>

Reply To : Smujo Editors <editors@smujo.id>

DEWI ELFIDASARI, FAHMA WIJAYANTI, AFIFATUS SHOLIHAH:

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Our decision is to: Accept Submission

Smujo Editors
editors@smujo.id

[biodiv] Editor Decision

From : Smujo Editors <smujo.id@gmail.com> Sel, Jun 02, 2020 12:39 PM

Subject : [biodiv] Editor Decision

To : DEWI ELFIDASARI <d_elfidasari@uai.ac.id>, FAHMA WIJAYANTI <fahma.wiyaja@yahoo.com>, AFIFATUS SHOLIHAH <afifatussholihah08@gmail.com>

Reply To : Smujo Editors <editors@smujo.id>

DEWI ELFIDASARI, FAHMA WIJAYANTI, AFIFATUS SHOLIHAH:

The editing of your submission, "Trophic level and position of Pterygoplichthys pardalis in Ciliwung River (Jakarta, Indonesia) ecosystem based on the gut content analysis," is complete. We are now sending it to production.

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Dear Editor of Biodiversitas Journal Hereby I submit the revised manuscript according to the advice of the reviewer regarding the manuscript references Sincerely elfidasaridewi, Trophic level and Position of Pterygoplichthys pardalis in Ciliwung River ecosystem_DewiElfidasari_Rev_References.doc	elfidasaridewi 2020-04-17 01:47 AM

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Deka (deka)

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2020-05-27 10:38 AM

Dewi Elfidasari, Fahma Wijayanti, Afifah:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "Trophic level and Position of Pterygoplichthys pardalis in Ciliwung River ecosystem based on the gut content analysis".

Our decision is: Revisions Required

Smujo Editors
editors@smujo.id

Reviewer A:

The manuscript is of good scientific quality. There is just some comments put in the text.

Recommendation: Accept Submission

[biodiv] Editor Decision

2020-05-27 10:38 AM

Dewi Elfidasari, Fahma Wijayanti, Afifah:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "Trophic level and Position of Pterygoplichthys pardalis in Ciliwung River ecosystem based on the gut content analysis".

Our decision is: Revisions Required

Smujo Editors
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Reviewer A:

The manuscript is of good scientific quality. There is just some comments put in the text.

Recommendation: Accept Submission

[biodiv] Editor Decision

2020-06-02 05:37 AM

DEWI ELFIDASARI, FAHMA WIJAYANTI, AFIFATUS SHOLIHAH:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "Trophic level and position of Pterygoplichthys pardalis in Ciliwung River (Jakarta, Indonesia) ecosystem based on the gut content analysis".

Our decision is to: Accept Submission

Smujo Editors
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Biodiversitas Journal of Biological Diversity

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DEWI ELFIDASARI, FAHMA WIJAYANTI, AFIFATUS SHOLIHAH:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "Trophic level and position of Pterygoplichthys pardalis in Ciliwung River (Jakarta, Indonesia) ecosystem based on the gut content analysis".

Our decision is to: Accept Submission

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editors@smujo.id

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Notifications

[biodiv] Editor Decision

2020-06-02 05:39 AM

DEWI ELFIDASARI, FAHMA WIJAYANTI, AFIFATUS SHOLIHAH:

The editing of your submission, "Trophic level and position of Pterygoplichthys pardalis in Ciliwung River (Jakarta, Indonesia) ecosystem based on the gut content analysis," is complete. We are now sending it to production.

Submission URL: https://smujo.id/biodiv/authorDashboard/submission/5754

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[biodiv] Editor Decision

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